NMAC 20.2.50.113
Engines & Turbines

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Direct Testimony
Rebuttal Testimony

NMAC 20.2.50.113
Engines & Turbines

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Key Takeaways – Engines & Turbines [20.2.50.113]

- Errors in NMED engine inventory data
- Assumptions in LEC and SCR Technology
- Request to have CO removed from rule
- Limits for existing engines in many instances will be technically infeasible
- Proposed regulations are more stringent for lean burn engines over rich burns
- Emission limits for new engines are in some instances technically infeasible
- Turbine emission limits are technically infeasible for smaller horsepower
- Maintenance rules should be structured intentionally to address ground level ozone generation
- Misc/General

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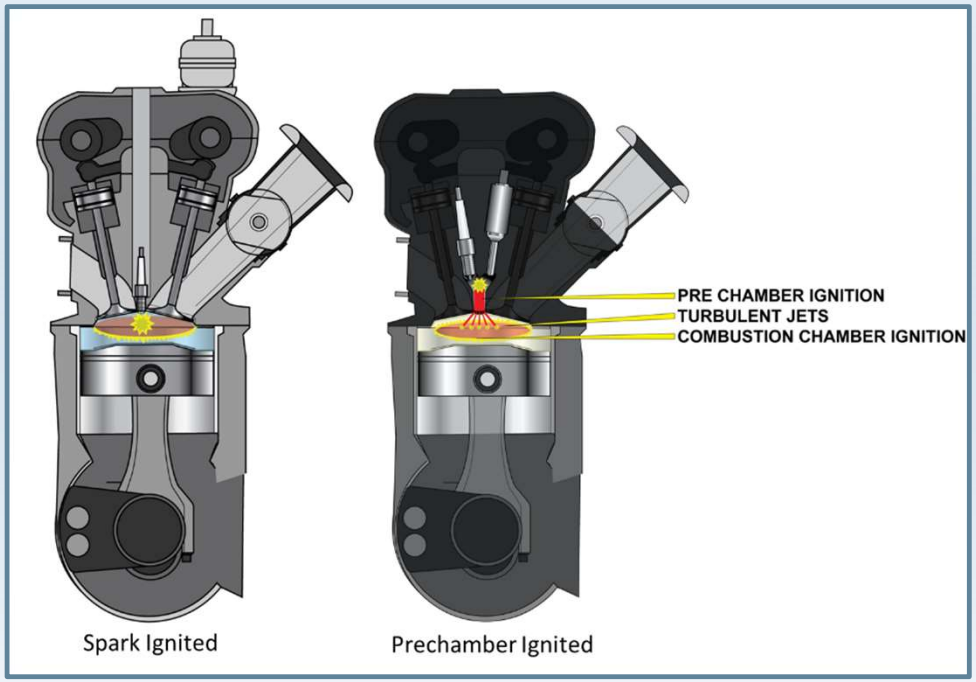
Database Errors (Engines)

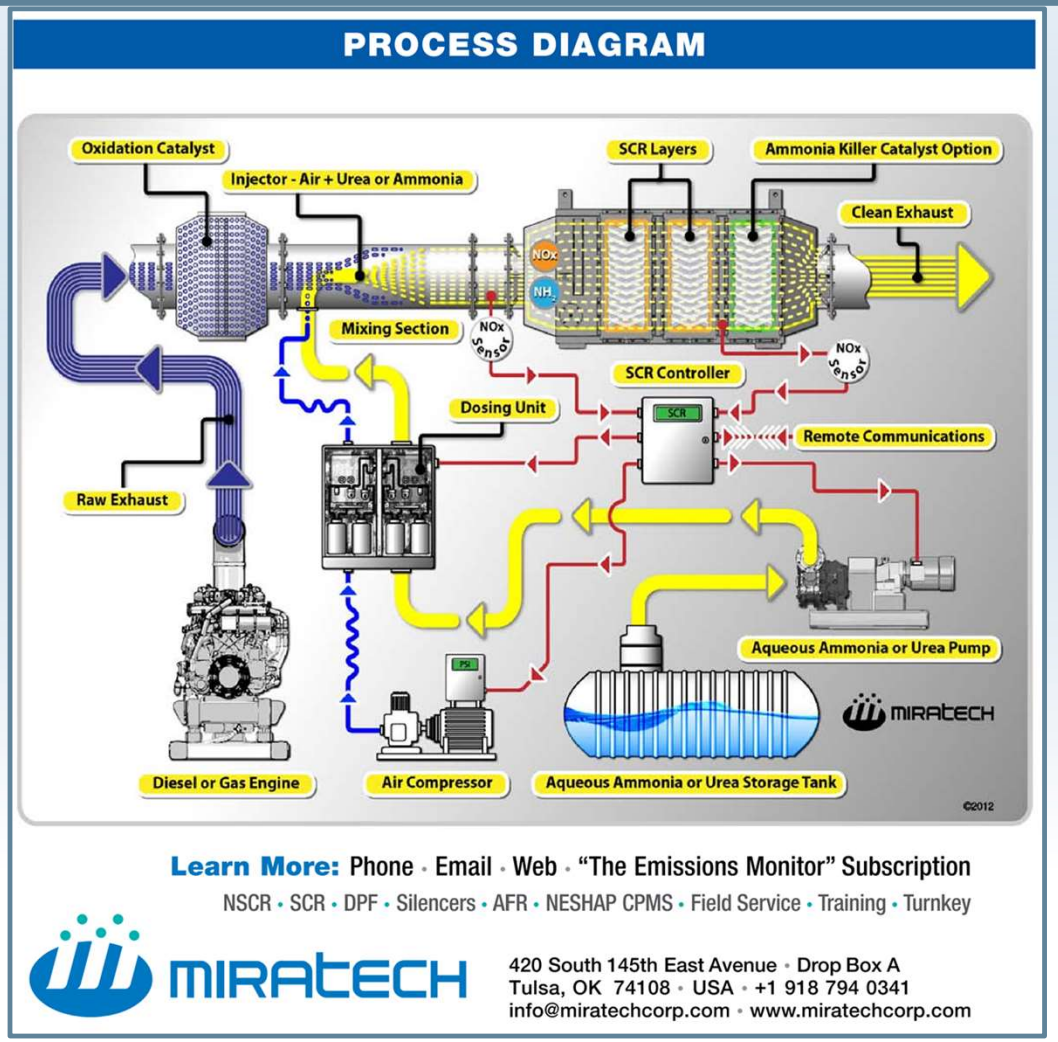
- Approximately 15% of the input data was found to be in error.
- Consequently, the NOx and VOC tonnage approximations are incorrect.
- These errors can be found in in both “ICE Reductions and Costs VOC 6-4-21_erg (06-08-2021R).xlsx” and “ICE Reductions and Costs NO2 6-4-21_erg (06-08-2021).xlsx”
- An accurate analysis of NOx and VOC emissions cannot be performed until database corrected.

LEC, NSCR, and SCR Technology

- Low Emission Combustion (LEC) Technology
  - More complex than a blanket solution for existing engines
  - In this context, applies to Lean Burn engines only
  - Many factors for applicability include engine model and architecture, vintage, etc.
  - Hoerbiger (Cooper Machinery Services) low NOx upgrades are not widely applicable
  - NOx “Adsorber” technology not commercially applicable
- Non-Selective Catalytic Reduction
  - Passive catalyst for rich burn engines, functioning by alternative rich/lean of stoichiometric
  - Multipoint AFR controllers needed for tight control
  - Can achieve very low NOx levels but are limited by AFR set-points, natural drift, and catalyst degradation
- Selective Catalytic Reduction (SCR) Technology
  - Allows for NOx reduction in oxidative environment. Injects reagent downstream of engine (i.e. urea)
  - Expensive to install and operate, disproportionately for smaller engines and/or turbines
  - Can be very complicated, requires on-site power that may not be readily available.
  - Very limited, if any, instances of application in oil and gas gathering operations.

LEC (Prechamber Ignition) and SCR





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CO

- CO is not a precursor to ozone creation and should be removed or mirror NSPS JJJJ at 2.0 g/bhp-hr.
- CO and NOx has an inverse relationship when operating in a lean environment, therefore as combustion temps are lowered to decrease NOx (which is a function of temp) then the results are two-fold
    1. CO rises sharply and more dependance is placed on the catalyst
    2. With decreasing combustion temps, catalyst housing temps decrease and lower catalyst performance

Table 1 (Existing Spark Ignition Engines)

NMED Proposed Table 1

Table 1 - EMISSION STANDARDS FOR NATURAL GAS-FIRED SPARK-IGNITION ENGINES CONSTRUCTED, RECONSTRUCTED, OR INSTALLED BEFORE THE EFFECTIVE DATE OF 20.2.50 NMAC.

Engine Type	Rated bhp	NO_x	CO	NMNEHC (as propane)
Lean-burn	>1,000	0.50 g/bhp-hr	47 ppmvd @ 15% O_2 or 93% reduction	0.70 g/bhp-hr
Rich-burn	>1,000	0.50 g/bhp-hr	0.60 g/bhp-hr	0.70 g/bhp-hr

Maximum Engine BHP	Emission Standards (g/bhp-hr)		
	NOx	CO	VOC
4 Stroke ~~All~~ Lean Burn engines >1000 bhp (4-stroke)	2.0	2.0	0.7
2-Stroke Lean Burns* >1000 bhp	3.0	2.0	0.7
All Rich Burn engines > 1000 bph	0.5	0.6	0.7

NMOGA Proposed Redline

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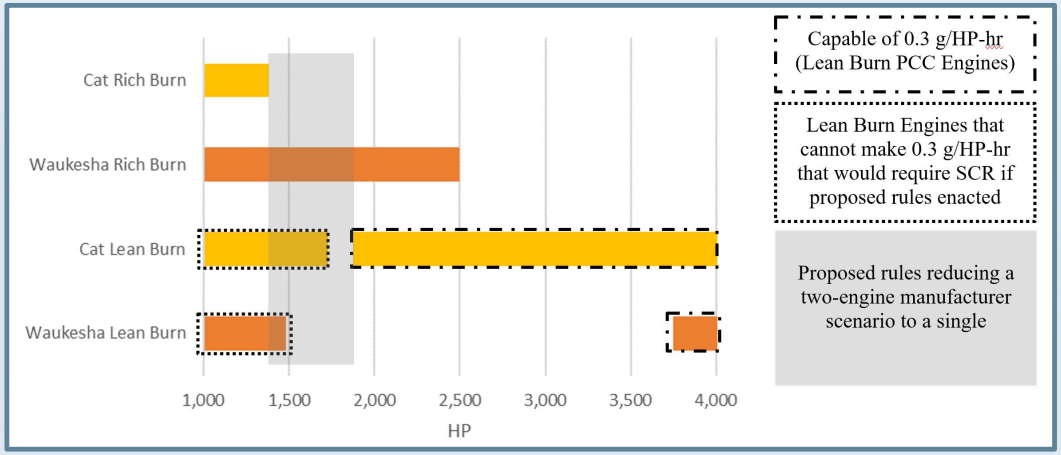
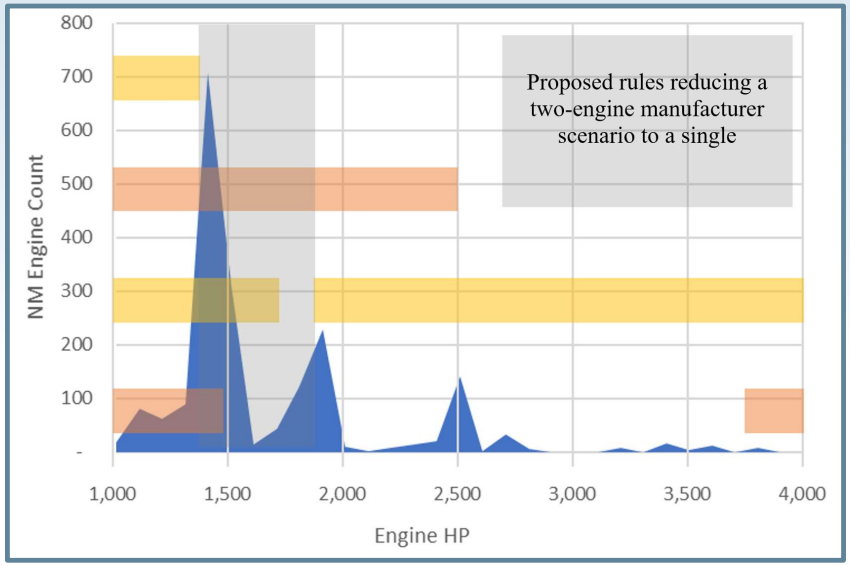
Table 1 (Existing Spark Ignition Engines)

Maximum Engine BHP	Emission Standards (g/bhp-hr)		
	NOx†	CO*	VOC
All engines >1000 bhp (4-stroke)	2.0 This is a preferred limit and more technically achievable for older engines that cannot meet the limits without significant LEC retrofit costs, often exceeding the cost of engine replacement. In many instances, applying all the available LEC technology won't achieve 1.0	2.0 * CO is not a precursor to ozone creation and should be removed or mirror NSPS JJJJ at 2.0 g/bhp-hr.	0.7
2-Stroke Lean Burns† >1000 bhp	3.0		





Reference Colo 5-CCR-1001-9 Part E, Table 1, as applicable to 20.2.50 NMAC (JJJJ) and
†2-Stroke Lean Burn > 1000 bhp, Reference Colo 5-CCR-1001-9 Part E, Table 2.
+ Construction definition does not include "relocation"

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Table 2 (New Spark Ignition Engines)

NMED Proposed Table 2

Table 2 - EMISSION STANDARDS FOR NATURAL GAS-FIRED SPARK-IGNITION ENGINES CONSTRUCTED, RECONSTRUCTED, OR INSTALLED AFTER THE EFFECTIVE DATE OF 20.2.50 NMAC.

Engine Type	Rated bhp	NO_x	CO	NMNEHC (as propane)
Lean-burn	>500 - <1,000	0.50 g/bhp-hr	0.60 g/bhp-hr	0.70 g/bhp-hr
Lean-burn	≥1,000	0.30 g/bhp-hr uncontrolled or 0.05 g/bhp-hr with control	0.60 g/bhp-hr	0.70 g/bhp-hr
Rich-burn	>500	0.50 g/bhp-hr	0.60 g/bhp-hr	0.70 g/bhp-hr

Engine Type	Engine (bhp)	Emissions (g/bhp-hr)		
		NOx	CO	VOC
4-Stroke Lean Burn engines	>1000 bhp and < 2370	0.7	2.0	0.7
4-Stroke Rich Burn engines	>1000 bhp and < 2370	0.5	2.0	0.7
All engines	≥2370 bhp	0.3	2.0	0.7

NMOGA Proposed Redline

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Table 2 (New Spark Ignition Engines)

Proposed Table 2 – Engine Agnostic

Engine Type	Engine (HP)	Emissions (g/HP-hr)		
		NOx	CO*	VOC
All Engines	>1000 HP	>0.7† †0.5 g/HP-hr can be very difficult but technically achievable, however, an emission limit of 0.7 g/HP-hr is more technically feasible and operationally practical allowing for variable and high BTU fuel gas and allow for longer usable life of catalyst elements.	2.0	0.7

Alternative Proposed Table 2 – Tiered

Engine Type	Engine (HP)	Emissions (g/HP-hr)		
		NOx	CO*	VOC
Lean Burn†	>1000 - <1875	0.7	2.0	0.7
	≥1875	0.3		
Rich Burn	>1000	0.5		

†If "relocation" triggers the application of "new engine" limits, then the HP tiering needs to be adjusted to 2370 HP

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*CO is not a precursor to ozone creation and should be removed or mirror NSPS JJJJ at 2.0 g/bhp-hr.

Turbines (Table 3)

Table 3 - EMISSION STANDARDS FOR STATIONARY COMBUSTION TURBINES

For each natural gas-fired combustion turbine constructed or reconstructed and installed before the effective date of 20.2.50 NMAC, the owner or operator shall ensure the turbine does not exceed the following emission standards no later than two years from the effective date of this Part:

Turbine Rating (bhp)	NO_x (ppmvd @15% O_2)	CO (ppmvd @ 15% O_2)	NMNEHC (as propane, ppmvd @15% O_2)
≥1,000 and <5,000	50	50	9
≥5,000 and <15,000	50	50	9
≥15,000	50	50 or 93% reduction	5 or 50% reduction

- Change Category to >4000 hp
- Alternatively adopt KKKK limits for this category 150ppm

For each natural gas-fired combustion turbine constructed or reconstructed and installed before the effective date of 20.2.50 NMAC, the owner or operator shall ensure the turbine does not exceed the following emission standards no later than two years from the effective date of this Part:

Turbine Rating (bhp)	NO_x (ppmvd @15% O_2)	CO (ppmvd @ 15% O_2)	NMNEHC (as propane, ppmvd @15% O_2)
≥1,000 and <5,000	50	50	9
≥5,000 and <15,000	50	50	9
≥15,000	50	50 or 93% reduction	5 or 50% reduction

- Change Category to >4000 hp
- Alternatively adopt KKKK limits for this category 100ppm

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Maintenance Rules

- Maintenance requirements already exist within ZZZZ and this section should be consistent with that rule. Stationary engine catalysts, housings, and exhaust piping can be provided by either the engine manufacturer or a catalyst supplier such that following engine manufacturer maintenance guidelines may not have an overall impact on emissions.
- Good maintenance is required to pass annual emission testing. Many operators establish their own maintenance programs that are more robust.
- The rule requires that routine maintenance and unscheduled repairs >2 hours duration in a 24 hr period be documented. This creates an administrative burden and has no evidence to support any negative or positive impact on ozone.
- Removal of engines and/or turbines for service should not trigger “new” emission standards

General / Misc

- Definition of “Construction” includes “Relocation” and suggested clarification
- The proposed rules require engines and turbines to meet standards upon startup which is not technically practical. A 180 day grace period is proposed by NMOGA
- Water/Steam injection is antiquated technology and therefore not an applicable solution. Additionally, requires large volumes of deionized water
- Alternative compliance plans
- Reducing operating hours to achieve a 95% reduction in NOx and VOC is not appropriate
- Technical and economic challenges for small HP rich burn limits

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General / Misc

- Pennsylvania GP-5 rule is not an appropriate analog
- GP is more intended to be focused on midstream and downstream providers. From discussions, many engines in gathering service are operating under exemption 38
- This is indicative that GP-5 is not absolute but instead contains options for exemptions, with similar options not currently available in the proposed NMED rule. If NMED references GP-5 as supportive of proposed emission limits, they should also consider some of the off ramps/exemptions for challenged applications.
- Referencing a standard doesn't tell us what can be achieved, just what the regulation says. A better reference would be whether these standards are being achieved in practice or if a shift to larger engines or electric motors is being made. A check against number of units operating under Exemption 38 should be explored.
- Similarly, GP-5 put in place rules for turbines that were unachievable, but no units were in service that were impacted

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General/Misc - National Parks Service Rebuttal

- This is a technically infeasible target. There are significant challenges and costs associated with this extremely low limit. As emission limits on a rich burn become more stringent, the necessary tight operation of AFR control becomes more critical, which is challenged with variable fuel, catalyst degradation (especially in sour service) and variable load conditions.
- For all of NPS's emission recommendations below 1000 HP, this argument has been raised and refuted in other rulemakings (e.g., Colorado) echoing that an extremely low NOx limit may be initially achieved, but cannot be met over time due to many factors including catalyst degradation, AFR drift, and other parameters. NMOGA Exhibit 54, provides an example of this argument that was made during the Colorado rule making.
- The reality is that most small horsepower rich burns are post-2006 vintage which means they likely already have NSCR installed and are not considered uncontrolled, i.e. the annual tonnage. It also creates a significant operational burden of expanding annual compliance testing for a much larger engine inventory, which is not practically feasible.

NPS PROPOSED LIMITS

Rich-burn Engines

- Require all *new* and *existing* rich-burn engines >500 HP to meet a limit of 0.2 g NO_x/hp-hr (NMED proposed 0.5 g NO_x/hp-hr)
- Require all *new* and *existing* rich-burn engines >100 HP and ≤500 HP to meet a limit of 0.25 g NO_x/hp-hr (NMED did not propose limits for this size class)
- Require all *new* rich-burn engines ≤ 100 HP to meet a proposed limit of 1.0 g NO_x/hp-hr (NMED did not propose limits for this size class)

Lean-burn Engines

- Require all *existing* lean-burn engines ≤100 HP to meet a proposed limit of 2.0 g NO_x/hp-hr (NMED did not propose limits for this size class)
- Require all *existing* lean-burn engines >100 and ≤500 HP to meet a proposed limit of 1.0 g NO_x/hp-hr (NMED did not propose limits for this size class)
- Require all *existing* lean-burn engines >500 HP to meet the proposed limit of 0.5 g NO_x/hp-hr (NMED proposed this limit for all *existing* engines greater than 1,000 HP)
- Require all *new* lean-burn engines ≤500 HP to meet a proposed limit of 1.0 g NO_x/hp-hr (NMED did not propose limits for this size class)

Existing Turbines

- Require all *existing* turbines ≥1,000 and <5,000 HP to meet a NO_x limit of 25 ppmvd @15% O_2 (NMED proposed a limit of 50 ppmvd @15% O_2 for all turbine size classes)
- Require all *existing* turbines ≥ 5,000 HP and <60,000 HP to meet a NO_x limit of 15 ppmvd @15% O_2 (NMED proposed a limit of 50 ppmvd @15% O_2 for all turbine size classes)
- Require all *existing* turbines ≥ 60,000 HP to meet a NO_x limit of 9 ppmvd @15% O_2 (NMED proposed a limit of 50 ppmvd @15% O_2 for all turbine size classes)

- I am not aware of any lean burn engines in this horsepower range. To my knowledge, small horsepower natural gas engines are entirely (or nearly) rich-burn engines, and post-2006 units already have NSCR installed.

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Summary – Engines & Turbines [20.2.50.113]

- Errors in NMED engine inventory data
- Assumptions in LEC and SCR Technology
- Request to have CO removed from rule
- Limits for existing engines in many instances will be technically infeasible
- Proposed regulations are more stringent for lean burn engines over rich burns
- Emission limits for new engines are in some instances technically infeasible
- Turbine emission limits are technically infeasible for smaller horsepower
- Maintenance rules should be structured intentionally to address ground level ozone generation
- General/Misc.

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Questions

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Surrebuttal Testimony

NMAC 20.2.50.113
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Compliance Schedule

- Compliance deadline for engines are staggered through 2029 such that turbines should be afforded the same compliance schedule. Currently NMED has the staggered compliance deadline to be completed by 2028
- If "construction" is redefined to not include relocation, then NMED appropriately captured the relevant HP cutoffs for existing and new lean burn engines. 1,775HP is the starting HP for the Cat G3600 A3 engines which is not capable of meeting 0.3g/hp-hr. whereas 1,875HP is the current minimum HP of the G3600s A4 engines which can meet that limit.
- Lean burns still being overly scrutinized at 0.3g NOx/hp-hr
  - Only two product offerings can meet 0.3g Nox
  - Limits future product offerings from new or existing manufacturers

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- CO removed from the rule rejected by NMED and allowing for CO to be used as a surrogate for NMNEHC in portable testing protocols. Request some clarifying language in redlines

Section C (4) – the original NMOGA redline submittal was provided with the request that CO would be removed from the rule. However, if CO remains in the rule, it is requested to clarify the language that initial and annual testing is a NOx and CO test

(43) For equipment operated for 500 hours per year or more, compliance with the emission standards in Subsection B of 20.2.50.113 ~~NMAC~~ NMAC shall be demonstrated within 180 days of the effective date applicable to the source as defined by Subsection B(2) and (7) or, if installed more than 180 days after the effective date, within 60 days after achieving the maximum production rate at which the source will be operated, but not later than 180 days after initial startup of such source. Compliance with the applicable emission standards shall be demonstrated by performing an initial emission test for NOx and VOC, as defined in 40 CFR 51.100(s) using U.S. EPA reference methods or ASTM D6348. Periodic monitoring shall be conducted annually to demonstrate compliance with the allowable emission standards and may be demonstrated utilizing a portable analyzer or EPA reference methods. ~~by performing an initial emissions test, followed by annual tests, for NO_x, CO, and non-methane non-ethane hydrocarbons (NMNEHC) using a portable analyzer or U.S. EPA reference method.~~ For units with g/hp-hr emission standards, the engine load shall be calculated using the following equations:

(i) for emissions testing using a portable analyzer, the results of emissions testing demonstrating compliance with the emission standard for CO may be used as a surrogate to demonstrate compliance with the emission standard for NMNEHC.

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NMAC 20.2.50.114 Compressor Seals

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Senior Project Manager & Facility Specialist

Direct Testimony
Rebuttal Testimony

NMAC 20.2.50.114
Compressor Seals

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Compressor Seals and Packing

- Valor recommends striking this section or at a minimum removing the “collect compressor vents under negative pressure.”
- “Negative pressure” is overly prescriptive, could result in oxygen entrainment (safety concern), and does not allow flexibility for new technology or new facility concepts.
- Because it is not common practice to collect the gas from reciprocating compressor seal, there is no industry standard for implementation. Because of this, operators will just elect to replace the reciprocating compressor rod packing at the specified time or hour interval (every 26,000 hours of compressor operation, or every 36 months, whichever is reached later) making this other compliance option irrelevant.
- For compressors located in buildings, venting gas creates a high fire risk such that operators already monitor packing and seals to mitigate the risk and keep gas detectors from alarming.

ERG - Compressor Seal Emission Impact

DRAFT MEMORANDUM

TO: Elizabeth Kuehn, NMED AQB
FROM: Mike Pring, Eastern Research Group, Inc. (ERG)
Brian Palmer, ERG
Stephen Treimel, ERG
DATE: June 4, 2021
SUBJECT: Emissions Inventory Reductions

The purpose of this memorandum is to document the emission reductions estimated to result from the requirements of the draft Ozone Precursor Rule for Oil and Natural Gas Sector under consideration by the New Mexico Environment Department (NMED).[1] This analysis was prepared for NMED by ERG under Professional Services Contract number 2066740400006.

Tables 1 and 2 show the estimated emission reductions as a result of the draft rule for NOx and VOC, respectively.

Table 2. Estimated VOC Emission Reductions

Source Type	Rule Section	Pre-Rule VOC (tons/year)	Post-Rule VOC (tons/year)	VOC Reduction (tons/year)	VOC Reduction (%)
Engines and Turbines	113	32,061	29,886	2,175	6.8%
Compressor Seals	114	13	6	6	51.3%
Equipment Leaks	116	26,025	6,475	19,550	75.1%
Gas Well Liquids Unloading	117	13,020	6,510	6,510	50.0%
Glycol Dehydrators	118	15,337	8,778	6,559	42.8%
Heaters	119	619	619	-	-
Hydrocarbon Liquids Transfers	120	11,681	1,542	10,139	86.8%
Pig Launching and Receiving	121	0.2	0.2	-	-
Pneumatic Controllers and Pumps	122	49,659	4,678	44,981	90.6%
Storage Tanks	123	54,424	31,429	22,995	42.3%
	Total	**202,839**	**89,924**	**112,915**	**55.7%**

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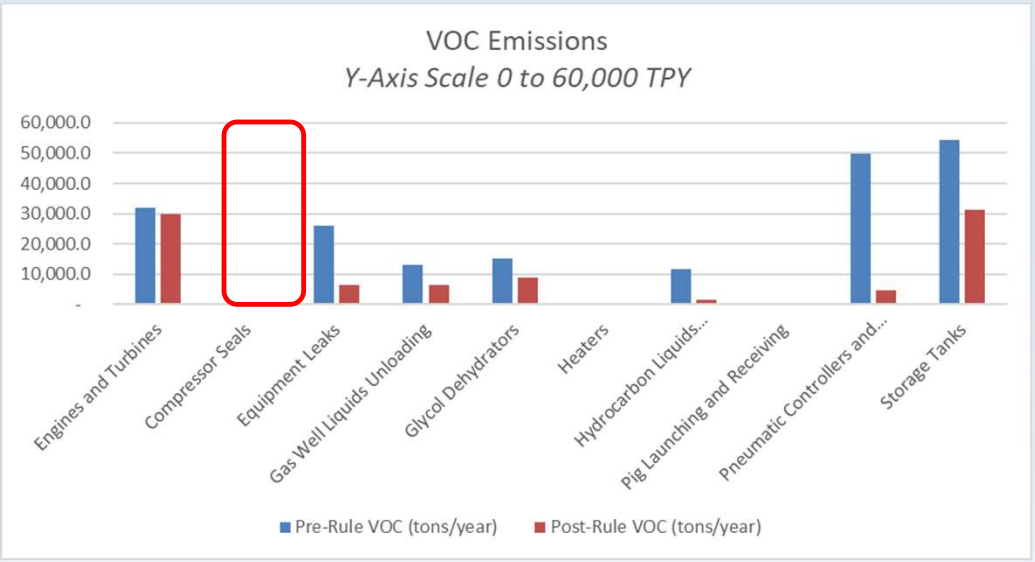
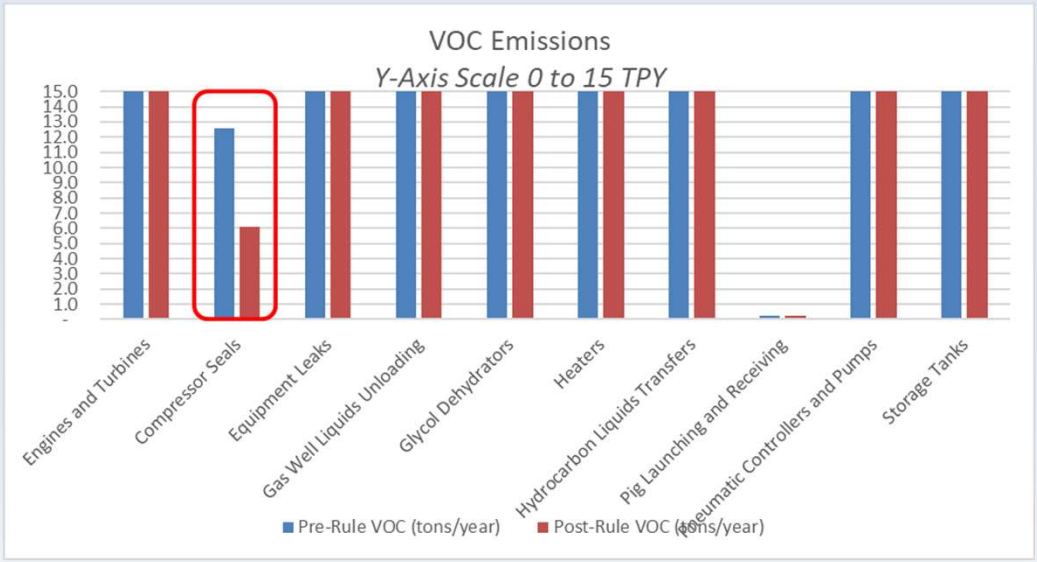
ERG - Compressor Seal Emission Impact





Mr. McNally testified that changes in the hundreds of tons of VOC emissions would not impact the emissions reductions achieved by the rule, indicating that eliminating this costly and burdensome rule and its 6 tons would not impact the reductions.

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Questions

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